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# Post-Traumatic Stress Disorder Predicts Future Weight Change in the Millennium Cohort Study

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**Objective:** To prospectively examine the association between post-traumatic stress disorder (PTSD) and weight change.

**Methods:** Longitudinal analysis techniques were used to examine data (2001–2008) from Millennium Cohort Study participants, consisting of U.S. service members and veterans. Using the PTSD Checklist–Civilian Version, PTSD was assessed as none, resolved, new onset, or persistent. Subsequent weight change was assessed as stable ( $\leq 3\%$  loss or gain),  $>3\%$  weight loss,  $>3\%$  but  $<10\%$  weight gain, and  $\geq 10\%$  weight gain.

**Results:** Of the 38,352 participants, 2391 (6.2%) had PTSD (838 resolved, 1024 new onset, and 529 persistent), and 11% of participants subsequently had  $\geq 10\%$  weight gain. In multivariable models, PTSD was associated with higher odds of  $\geq 10\%$  weight gain (new onset OR: 1.44 [95% CI: 1.20–1.73]; persistent OR: 1.51 [CI: 1.17–1.96]; resolved OR: 1.30 [CI: 1.05–1.60]) compared with those without PTSD. New-onset and persistent PTSD were also associated with higher odds of  $>3\%$  weight loss (OR: 1.41 [CI: 1.17–1.71]; OR: 1.42 [CI: 1.09–1.86], respectively).

**Conclusions:** PTSD is independently associated with a higher risk of weight gain and loss, the former of which leads to a higher prevalence of overweight and obesity and a higher risk of comorbidities associated with excessive body adiposity.

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## Introduction

Post traumatic stress disorder (PTSD) is characterized by an abnormal neurobiological response to trauma, where the body remains in a perpetual state of hyperarousal and fear (1). These neurobiological changes cause a cascade of negative effects on the body, and in turn, those with PTSD often suffer from sleep deprivation, reduced immunity, emotional imbalance, and other related issues. Therefore, not surprisingly, PTSD is also associated with a variety of adverse health conditions, many of which are also related to excess weight,

and include depression, alcohol misuse, cardiovascular disease, diabetes, reduced quality of life, and poorer mental and physical health (2–4).

While PTSD is associated with overweight and obesity in military veterans (5,6) and in members of the general population (7), the temporal relationship between PTSD symptoms and weight change has not been well established. PTSD is associated with a host of physiologic changes affecting the central and peripheral nervous

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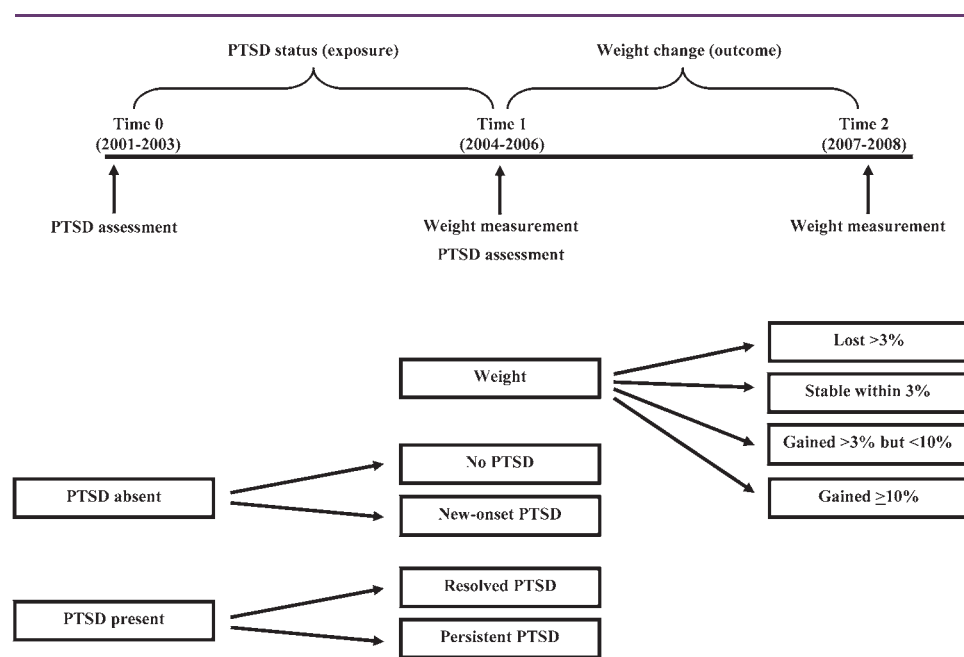
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**Author contributions:** All authors were involved in designing the study, interpreting the data, and writing the manuscript. All authors critically revised the manuscript and approved the final version. CAL, KAW, IGJ, and BS acquired the data and created a clean data set. CAL and KAW performed the statistical analyses and generated the tables and figure. CAL affirms that the manuscript is an honest, accurate, and transparent account of the study being reported, that no important aspects of the study have been omitted, and that any discrepancies from the study have been explained.

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**Figure 1** Study design for the longitudinal measurement of post traumatic stress disorder (exposure) and subsequent 3 year weight change (outcome).

systems, including neuroendocrine, serotonergic, and autonomic nervous system dysregulation (8). As the central nervous system plays a key role in appetite regulation, it is plausible that PTSD may be associated with subsequent weight gain or loss (9). There are multiple potential mechanisms for weight changes in individuals with PTSD: (1) sleep deprivation caused by PTSD, as shorter sleep duration has been linked to higher obesity prevalence (10), (2) emotional or mood states of those with PTSD may decrease physical activity (11), (3) PTSD associated coping mechanisms, such as unhealthy eating and dieting behaviors (12), and (4) medications prescribed for PTSD that may affect body weight (13). Since obesity increases the risk of numerous medical conditions, it is essential to understand the temporal relationship between PTSD and weight changes. Currently available research on the association between PTSD and weight change is mostly based on cross sectional data. The few prospective studies have relied on retrospective ascertainment of traumatic events or post traumatic stress symptoms among nonmilitary populations and therefore have not definitively established whether PTSD symptoms temporally precede changes in weight among current and former service members (6,14,15). Prospective research is needed to better understand the association between PTSD onset, persistence, or remission, and subsequent changes in body weight or body mass index (BMI).

Our study addresses this knowledge gap by using longitudinal data from the Millennium Cohort Study, which was launched in 2001 that has prospectively followed U.S. military members for over a decade examining long term health effects related to military service (16). Using PTSD symptoms and self reported weight from baseline and follow up questionnaires as well as deployment data from Department of Defense (DoD) personnel files, we prospectively examined the relationship between PTSD and subsequent weight change in this cohort.

## Methods

### Study population

Individuals invited to participate in the Millennium Cohort Study were randomly selected from U.S. military rosters, with oversampling of selected subgroups of interest, as previously described (17). Between 2001 and 2003 (time 0), 77,047 consenting participants enrolled in the Millennium Cohort Study (36% of those believed to be contacted). Of these participants, 55,021 (71%) completed the first follow up survey between 2004 and 2006 (time 1), and 54,790 (71%) completed the second follow up survey between 2007 and 2008 (time 2). Further details of the methodology of the Millennium Cohort Study have been previously described (17,18).

This study included participants who completed questionnaires at all three time points ( $n = 46,437$ ) and had complete demographic, occupational, weight, PTSD, and covariate data ( $n = 39,053$ ). Women who reported giving birth in the previous 3 years on any one of the surveys were excluded from the analyses ( $n = 701$ ). The final study population for these analyses was 38,352. Figure 1 shows the study design and the timing of the exposure and outcome assessments. This study was approved by the Naval Health Research Center Institutional Review Board, and written informed consent was obtained from all subjects.

### Exposure

The main exposure was the change in PTSD screening status between time 0 and 1 using the PTSD Checklist Civilian Version (PCL C). The PCL C included in the Millennium Cohort survey is a validated instrument used to rate the severity of 17 PTSD symptoms (19,20). Based on meeting the *Diagnostic and Statistical Manual of Mental Disorders*, 4th Edition, Text Revision criteria for PTSD



(21,22), participants were classified as having a positive PTSD screen if they reported a moderate or greater level of at least one intrusion symptom, three avoidance symptoms, and two hyperarousal symptoms (19–21). Participants were divided into four categories: (a) no PTSD (negative at times 0 and 1), (b) resolved PTSD (positive at time 0 and negative at time 1), (c) new onset PTSD (negative at time 0 and positive PTSD at time 1), and (d) persistent PTSD (positive at both time points).

## Outcome

Percent weight change was calculated as the difference in self-reported weight between time 2 and 1, divided by the weight reported at time 1, and multiplied by 100. Based on clinically relevant changes of body weight and consistent with categories previously defined in this cohort (23), the weight change percentages were classified into the following four categories: stable weight (remained within 3% of weight), >3% weight loss, >3% but <10% weight gain, and ≥10% weight gain.

## Covariates

Demographic and military specific data were obtained from DoD electronic personnel files maintained by the Defense Manpower Data Center, including sex, birth year, highest education level, race/ethnicity, marital status, deployment in support of operations in Iraq and Afghanistan, date of military separation, pay grade, service component, service branch, and occupation. With the exception of deployment and separation, characteristics were measured at time 0.

Participants who deployed in the support of operations in Iraq and Afghanistan at least once between times 0 and 2 were classified as deployed. Combat related experiences, reported at time 1 or 2, were based on affirmative responses to questions about witnessing death, trauma, injuries, prisoners of war, or refugees in the last 3 years. Deployment duration was the cumulative time between in and out of theater dates. Time since military separation was calculated as the difference in time between the date of separation and the date of completion of the questionnaire at time 2.

Behavioral factors that may confound the relationship between PTSD and weight change were included in the analyses. For the purposes of this study, an aggregate (yes/no) measure was created to adjust for mental health symptoms/disorders assessed at time 0. Participants who (1) self reported receiving a health care professional diagnosis of depression, schizophrenia, psychosis, or manic depressive disorder; (2) screened positive for major depression, panic disorder, or other anxiety disorders (using standardized scoring Patient Health Questionnaire [PHQ] algorithms); (24–26) or (3) reported taking medication for anxiety, stress, or depression were categorized as having a prior mental disorder. Self report of ever being diagnosed by a medical provider with PTSD was also assessed at time 0.

Behavioral factors that may be associated with weight change (sleep, binge eating, and alcohol and tobacco use) were assessed at time 0. Sleep duration was categorized as <6, 6, 7, 8, and >8 hours per day. Binge like eating disorder was assessed based on responses to the PHQ. Women who reported drinking more than seven alcoholic drinks per week or four or more drinks per occasion or day and men who reported drinking more than 14 drinks per week or five or more drinks per occasion or day at time 1 were considered heavy/

binge drinkers (27). Smoking status was categorized as never, past, and current smoker.

## Statistical analysis

Descriptive and univariable analyses were conducted to compare demographic and behavioral characteristics between the four PTSD groups. Multinomial logistic regression analyses were performed to estimate the association between PTSD and subsequent 3 year change in weight and to calculate unadjusted and adjusted odd ratios (ORs) and 95% confidence intervals (CIs), while adjusting for demographic, military, mental health, and behavioral characteristics. Covariates were removed from the final model if they (1) were not significantly associated with weight change, and (2) did not confound the association between PTSD and weight change (by ≥10%). To determine whether sex, age, smoking status, previous mental health conditions, hours of sleep, or depression modified the relationship between PTSD status and weight change, tests for a multiplicative interaction were performed; a *P* value of <0.10 was used to indicate a significant interaction in the model. Multicollinearity was assessed using a variance inflation factor of four or greater among independent variables.

In addition, supplemental analyses were performed to further understand the association between PTSD and weight change. Using binary logistic regression among those who were not obese (<30 kg/m<sup>2</sup>) at time 1, we examined if a positive PTSD screen was associated with obesity (≥30 kg/m<sup>2</sup>) at time 2. Secondly, PTSD may affect the likelihood of deployment and/or military separation, which may be in the casual pathway between PTSD and weight change. Therefore, using the same study population and main multinomial logistic regression model, we left out each of the following potentially mediating factors in three separate analyses: (1) deployment status, (2) years since military separation, and (3) both deployment status and years since military separation. To examine PTSD status over the entire period (2001–2008) in association with weight change, we fit a model that assessed PTSD status using data from all three questionnaires.

Data management and statistical analyses were performed using SAS statistical software, version 9.3 (SAS Institute, Inc., Cary, North Carolina).

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## Results

The study population comprised current and former service members who were mostly male (76%), non Hispanic white (72%), and married individuals (68%). The mean age at baseline (time 0) was 35.6 years (standard deviation, 8.9 years). Of the 2391 (6.2%) with PTSD at time 0 and/or 1, 1024 had new onset, 838 had resolved, and 529 had persistent PTSD (Table 1). Participants with resolved, new onset, and persistent PTSD were proportionally more likely to be female, younger, non Hispanic black or Hispanic, less educated, never married or divorced/other, enlisted, in the Army or Marine

**TABLE 1** Baseline characteristics of Millennium Cohort participants in relation to 3-year post-traumatic stress disorder screen status<sup>a</sup> (*N* = 38,352)

	PTSD screen status <sup>b</sup>							
	No PTSD ( <i>n</i> = 35,961)		Resolved ( <i>n</i> = 838)		New onset ( <i>n</i> = 1,024)		Persistent ( <i>n</i> = 529)	
	<i>n</i>	(%) <sup>c</sup>	<i>n</i>	(%) <sup>c</sup>	<i>n</i>	(%) <sup>c</sup>	<i>n</i>	(%) <sup>c</sup>
<b>Sex</b>								
Male	27,704	(77.0)	589	(70.3)	697	(68.1)	367	(69.4)
Female	8,257	(23.0)	249	(29.7)	327	(31.9)	162	(30.6)
<b>Birth year</b>								
Before 1960	9,676	(26.9)	170	(20.3)	210	(20.5)	140	(26.5)
1960-1969	15,246	(42.4)	292	(34.8)	407	(39.7)	193	(36.5)
1970-1979	9,997	(27.8)	321	(38.3)	340	(33.2)	160	(30.2)
1980 and later	1,042	(2.9)	55	(6.6)	67	(6.5)	36	(6.8)
<b>Race/ethnicity</b>								
Non-Hispanic white	26,099	(72.6)	595	(71.0)	711	(69.4)	369	(69.8)
Non-Hispanic black	3,769	(10.5)	109	(13.0)	138	(13.5)	80	(15.1)
Hispanic	1,962	(5.5)	61	(7.3)	74	(7.2)	48	(9.1)
Other	4,131	(11.5)	73	(8.7)	101	(9.9)	32	(6.0)
<b>Education</b>								
Some college or less	23,899	(66.5)	708	(84.5)	828	(80.9)	447	(84.5)
Bachelor's degree or higher	12,062	(33.5)	130	(15.5)	196	(19.1)	82	(15.5)
<b>Marital status</b>								
Never married	8,684	(24.1)	262	(31.3)	313	(30.6)	156	(29.5)
Married	24,792	(68.9)	503	(60.0)	614	(60.0)	319	(60.3)
Divorced, other	2,485	(6.9)	73	(8.7)	97	(9.5)	54	(10.2)
<b>Service component</b>								
Active duty	19,766	(55.0)	501	(59.8)	534	(52.1)	297	(56.1)
Reserve/National Guard	16,195	(45.0)	337	(40.2)	490	(47.9)	232	(43.9)
<b>Military pay grade</b>								
Enlisted	24,913	(69.3)	744	(88.8)	851	(83.1)	463	(87.5)
Officer	11,048	(30.7)	94	(11.2)	173	(16.9)	66	(12.5)
<b>Service branch</b>								
Air Force	11,075	(30.8)	173	(20.6)	177	(17.3)	78	(14.7)
Army	16,618	(46.2)	475	(56.7)	635	(62.0)	344	(65.0)
Marine Corps	1,432	(4.0)	36	(4.3)	47	(4.6)	26	(4.9)
Navy/Coast Guard	6,836	(19.0)	154	(18.4)	165	(16.1)	81	(15.3)
<b>Occupation</b>								
Combat specialist	7,809	(21.7)	142	(16.9)	190	(18.6)	96	(18.1)
Health-care specialist	4,124	(11.5)	83	(9.9)	102	(10.0)	62	(11.7)
Other	24,028	(66.8)	613	(73.2)	732	(71.5)	371	(70.1)
<b>BMI<sup>d</sup> mean (SD)</b>								
Male	26.6 (3.1)		27.0 (3.5)		27.2 (3.3)		27.6 (3.8)	
Female	24.3 (3.3)		25.2 (3.9)		24.8 (3.4)		25.2 (3.9)	

BMI = body mass index; PTSD = post traumatic stress disorder; SD = standard deviation.

<sup>a</sup>All characteristics were statistically significantly different ( $P < 0.05$ ) in univariable analyses.<sup>b</sup>PTSD screen status was measured between times 0 and 1. No PTSD indicates a negative screen at times 0 and 1, resolved indicates positive screen at time 0 and negative screen at time 1, new onset indicates negative screen at time 0 and positive screen at time 1, and persistent indicates positive screen at times 0 and 1.<sup>c</sup>Column percentages are rounded and may not sum to 100.<sup>d</sup>The population for mean BMI ( $N = 38,351$ ) varies from the total study population ( $N = 38,352$ ) because one participant did not self report height on any of the surveys.

**TABLE 2** Associations between post-traumatic stress disorder and subsequent 3-year weight change in multinomial logistic regression models (*N* = 38,352)

PTSD screen status <sup>a</sup>	Stable weight		Lost >3% <sup>b</sup>		Gained >3% but <10% <sup>b</sup>			Gained ≥10% <sup>b</sup>		
	<i>n</i>	<i>n</i>	OR <sup>c</sup>	95% CI	<i>n</i>	OR <sup>c</sup>	95% CI	<i>n</i>	OR <sup>c</sup>	95% CI
No PTSD	18,327	4390	1.00	Reference	9360	1.00	Reference	3884	1.00	Reference
Resolved	338	119	1.10	0.88-1.38	226	1.15	0.96-1.37	155	1.30	1.05-1.60
New onset	401	165	1.41	1.17-1.71	274	1.19	1.01-1.39	184	1.44	1.20-1.73
Persistent	190	90	1.42	1.09-1.86	141	1.26	1.00-1.59	108	1.51	1.17-1.96

CI = confidence interval; OR = odds ratio; PTSD = post traumatic stress disorder.

<sup>a</sup>PTSD screen status was measured between times 0 and 1. No PTSD indicates a negative screen at times 0 and 1, resolved indicates positive screen at time 0 and negative screen at time 1, new onset indicates negative screen at time 0 and positive screen at time 1, and persistent indicates positive screen at times 0 and 1.

<sup>b</sup>Reference category is stable weight. A 3 year weight change was measured between times 1 and 2. Stable weight indicates a change ≤3%.

<sup>c</sup>The model adjusted for the following variables at time 0: sex, birth year, race, education, military pay grade, service branch, hours of sleep, mental health symptoms/diagnosis, smoking status, and binge like eating disorders. Deployment status and military separation were measured between times 0 and 2, approximately 6 years later.

Corps, and in an occupation other than combat and healthcare compared with those with no PTSD at time 0 and 1 (Table 1).

Between times 1 and 2, 50.2% of the participants maintained a stable weight, 12.4% lost >3%, 26.1% gained >3% but <10%, and 11.3% gained ≥10% of their weight reported at time 1. Participants without PTSD were proportionally more likely to maintain stable weight (51.0%) than those with resolved (40.3%), new onset (39.2%), or persistent (35.9%) PTSD.

After adjusting for covariates, those with new onset and persistent PTSD were significantly more likely to subsequently gain >3% but <10% (new onset OR: 1.19 [95% CI: 1.01 1.39]; persistent OR: 1.26 [CI: 1.00 1.59]) and ≥10% (new onset OR: 1.44 [CI: 1.20 1.73]; persistent OR: 1.51 [CI: 1.17 1.96]) of their weight and to lose >3% of their weight (new onset OR: 1.41 [CI: 1.17 1.71]; persistent OR: 1.42 [CI: 1.09 1.86]) compared with participants who screened negative for PTSD (Table 2). Resolved PTSD was associated with an increased odds of ≥10% weight gain (OR: 1.30 [CI: 1.05 1.60]) compared with those who screened negative at both time points, but not more modest weight gain or weight loss (Table 2). The multivariable models were not stratified by sex, age, smoking status, previous mental health conditions, hours of sleep, or depression because none of these factors modified the association between PTSD screening status and subsequent weight change (*P* < 0.10). Adjusted associations (ORs and 95% CI) between the covariates and subsequent weight change are shown in the Supplementary Table.

In a supplemental analysis examining PTSD in relation to the development of obesity among participants who were not obese at time 1 (*n* = 31,727), 10.2% became obese at time 2 (Table 3). After adjusting for demographics, military characteristics, and behavioral and health status covariates, those with new onset (OR: 1.28 [CI: 1.04 1.59]) and persistent (OR: 1.66 [CI: 1.27 2.17]) PTSD were significantly more likely to subsequently develop obesity than those without PTSD.

Results from the supplemental analyses that removed the deployment and separation variables from the multivariable models due to their potential roles as mediating factors did not appreciably differ from the results shown in Table 2 (data not shown). Further, we

examined cumulative deployment duration (since deployments may entail changes in dietary quality and physical activity). However, cumulative deployment duration was neither significant nor a confounder in the relationship between PTSD and weight change. In addition, when PTSD status was changed to account for PTSD at all three time points, the magnitudes of the odds ratios remained similar to those shown in Table 2, while all PTSD categories, including those with resolved PTSD, reached statistical significance (data not shown).

## Discussion

In this study of service members and veterans, we found a significant association of PTSD with subsequent 3 year weight gain and the development of obesity. Among individuals who newly screened positive for PTSD (new onset) or screened positive at two consecutive time points (persistent), they were significantly more likely to gain greater than three percent of their baseline body weight compared with those who did not screen positive for PTSD. While those

**TABLE 3** Associations between post-traumatic stress disorder and development of obesity (*N* = 31,727)

PTSD screen status <sup>a</sup>	Nonobese to obese <sup>c</sup>			
	No. of obese/total	(%)	OR <sup>b</sup>	95% CI
No PTSD	2980/29,989	(9.9)	1.00	Reference
Resolved	88/625	(14.1)	1.13	0.89-1.43
New onset	109/750	(14.5)	1.28	1.04-1.59
Persistent	74/363	(20.4)	1.66	1.27-2.17

CI = confidence interval; OR = odds ratio; PTSD = post traumatic stress disorder.

<sup>a</sup>PTSD screen status was measured between times 0 and 1. No PTSD indicates a negative screen at times 0 and 1, resolved indicates positive screen at time 0 and negative screen at time 1, new onset indicates negative screen at time 0 and positive screen at time 1, and persistent indicates positive screen at times 0 and 1.

<sup>b</sup>The model adjusted for the following variables at time 0: sex, birth year, race, education, military pay grade, service branch, occupation, hours of sleep, smoking status, and binge like eating disorders. Military separation was measured between times 0 and 2, approximately 6 years later.

<sup>c</sup>BMI was measured between times 1 and 2. The categories were defined as by the World Health Organization.

with resolved PTSD were also at elevated odds for weight gain, the relationship was not as strong or consistent. These findings suggest that even when symptoms appear to improve, there may be some residual factors that may continue to influence changes in body weight. This persistent temporal association of PTSD with weight gain is consistent with other previous studies among veterans and female nurses (6,14). In addition, this study found that new onset and persistent PTSD was associated with weight loss. This psychological condition plays an important role in body weight regulation through mechanisms that as yet are undefined.

There are several potential mechanisms to explain the relationship between PTSD and subsequent weight gain or loss. Abnormal adaptation of neurobiological systems manifested by the stress of traumatic event(s) is believed to cause the symptoms of PTSD (1,28). It is possible that the dysregulation of neuroendocrine and autonomic nervous systems may directly affect sleep, metabolism, and appetite, which could cause changes in weight. There is mounting evidence indicating that traumatic events associated with PTSD may also be a trigger for eating disorder (7,29). While this link between PTSD and eating disorders may explain some increased risk of weight change, the relationships found in the current study were independent of binge eating, consistent with a previous study (7). PTSD symptoms have also been associated with unhealthy dieting and eating behaviors (12). These unhealthy behaviors, such as using laxatives, skipping meals, or increasing consumption of fast food and soda, may cause weight loss or gain. Further, there is evidence that individuals may over and under eat as a coping mechanism when they experience certain emotional states (30). Some previous studies have shown an association between PTSD and other negative coping behaviors, such as tobacco initiation and alcohol dependence (31). Tobacco users are significantly leaner and gain less weight over time compared with nonusers (32). The relationship between weight change and alcohol consumption is more complex and may depend on the amount and type of alcohol consumed (33). However, since we adjusted for alcohol and tobacco use, the association between PTSD and weight change in this study was independent of these comorbid coping behaviors. In addition, a further analysis indicated that smoking at time 0 did not modify the relationship between PTSD status and subsequent weight change.

Another possible explanation for the change in weight associated with PTSD may be pharmacotherapies prescribed for PTSD, including selective serotonin and selective serotonin norepinephrine reuptake inhibitors and atypical antipsychotic medications, which are frequently associated with weight gain and sometimes weight loss (13). Pharmacologic treatments for PTSD, however, were not assessed in this study. In addition, since PTSD status was assessed based on responses to survey questions, it is likely that some individuals who were classified as having PTSD did not seek medical attention or receive treatment. Further research will be required to distinguish effects of PTSD from its treatments.

These findings have important public health implications given that overweight and obesity are known risk factors for adverse health outcomes, including heart disease, type 2 diabetes, hypertension, dyslipidemia, stroke, breast and colon cancers, and early mortality (34,35). Our results suggest that increases in body weight may add to the morbidity associated with PTSD. Additional studies are needed to determine whether early and aggressive management of PTSD symptoms can avert the development of obesity among this group.

Excessive weight gain may also have important occupational and economic consequences, and in the military may adversely impact force readiness. Military service is often physically demanding, and members who are obese may be less able to perform physical tasks and more likely to be hospitalized than nonobese individuals (36). In addition, health problems associated with weight gain and/or obesity may result in periods of being unfit for deployment or career advancement. U.S. service members who gain excessive weight may also fail fitness tests and/or may no longer meet military weight standards, and therefore may be administratively managed and/or involuntarily separated from service, further affecting overall force readiness.

While those with PTSD were also at increased odds for weight loss ( $>3\%$ ), there were only 67 (1.5%) individuals in the weight loss group ( $n = 4764$ ) who were underweight ( $< 18.5 \text{ kg/m}^2$ ) at time 2. Moreover, 84% of this group weighed less at time 0 than time 1, indicating a fluctuation of body weight or a return to a previous weight rather than continuous weight loss over time. These findings suggest that weight loss among this group was not necessarily unhealthy and may be mostly a result of behaviors, such as dieting, which may cause fluctuations in weight that previously have been shown to be more common among those with PTSD (12).

There were several limitations to this study. Participants consisted of a sample of responders to the Millennium Cohort questionnaire leading to potential biases. However, investigations of such biases in the Millennium Cohort have found it to be a representative military sample who report reliable health data and who are not influenced to participate by poor health prior to enrollment (37,38). In addition, as with any prospective cohort study, loss to follow up may affect results, though analyses on weighting for nonresponse have not identified changes in metrics for PTSD, depression, and disordered eating (39). The PCL C was used to assess PTSD, and while it is a standardized and valid instrument, it is a surrogate for a clinician diagnosis and may misclassify PTSD status for some participants. Self-reported weight, which is likely not to be as accurate as measured weight, was used to assess change in body weight, and there was no assessment of whether any weight changes were intentional. However, when self-reported weight from the Millennium Cohort questionnaire was compared with fitness records within 60 days of each other among a sample of Air Force personnel, 75% reported weight within five pounds (3%) of the weight recorded on their fitness record, which was nondifferential by PTSD status. We also examined height variability since this affects BMI and found that 80% reported the same height over time and among those with differing heights, 96% differed only slightly ( $\leq 2$  inches).

Despite these limitations, there are important strengths of this study. It is the first to prospectively investigate the relationship between the onset, persistence, and remission of PTSD, and change in body weight. The study was conducted among a large cohort of service members and veterans from all service branches, including active duty, Reserve, and National Guard members. Furthermore, the use of PCL C survey data may capture a greater burden of disease compared with ambulatory or hospitalization data, since many with symptoms may not seek treatment for myriad reasons, including, for example, fear of attached stigma or implications for career advancement.

In conclusion, this study found that PTSD is associated with subsequent, significant changes in body weight including the development



of obesity among a population of service members and veterans. Persistent PTSD symptoms, compared with new onset or resolved, were most strongly associated with weight gain. Findings from this study add to the growing literature on the association of PTSD with generalized health problems and indicate that weight gain and development of obesity should be considered as important comorbidities for PTSD by military, veteran, and civilian clinical providers. Knowing the high prevalence of PTSD among deployed military personnel and veterans and the serious health consequences of both PTSD and obesity, the potential exists to improve clinical practices to address these associated comorbidities. Given the strong and consistent relationships revealed in this study between PTSD symptoms and weight gain among current and former military personnel, health care providers and policymakers should consider the importance of these findings and potential modifications to existing screening and treatment programs for PTSD. **O**

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<b>14. ABSTRACT</b> <p><b>Objective:</b> To prospectively examine the association between post-traumatic stress disorder (PTSD) and weight change.</p> <p><b>Methods:</b> Longitudinal analysis techniques were used to examine data (2001–2008) from Millennium Cohort Study participants, consisting of U.S. service members and veterans. Using the PTSD Checklist–Civilian Version, PTSD was assessed as none, resolved, new onset, or persistent. Subsequent weight change was assessed as stable (≤3% loss or gain), &gt;3% weight loss, &gt;3% but &lt;10% weight gain, and ≥10% weight gain.</p> <p><b>Results:</b> Of the 38,352 participants, 2391 (6.2%) had PTSD (838 resolved, 1024 new onset, and 529 persistent), and 11% of participants subsequently had ≥10% weight gain. In multivariable models, PTSD was associated with higher odds of ≥10% weight gain (new onset OR: 1.44 [95% CI: 1.20–1.73]; persistent OR: 1.51 [CI: 1.17–1.96]; resolved OR: 1.30 [CI: 1.05–1.60]) compared with those without PTSD. New-onset and persistent PTSD were also associated with higher odds of &gt;3% weight loss (OR: 1.41 [CI: 1.17–1.71]; OR: 1.42 [CI: 1.09–1.86], respectively). <b>Conclusions:</b> PTSD is independently associated with a higher risk of weight gain and loss, the former of which leads to a higher prevalence of overweight and obesity and a higher risk of comorbidities associated with excessive body adiposity.</p>					
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